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(54) Electrodes for electrostatic purposes

(57) In an electrode, a polymeric or textile nap or natural pelt (1) having low fibre conduction values is connected via a high-ohmic composite lamellar resistor (2,3) to the current supply. This composite lamellar resistor (2,3) may also act as an adhesive and be applied on an appropriately shaped rigid or pliable insulator (4) depending on the application of the electrode. The electrode is applicable for numerous electrostatic applications, e.g. such as gas purification plants, air filters, bioelectrics, electrical indoor climatisation, appliances for discharging electrostatically charged material and the like.

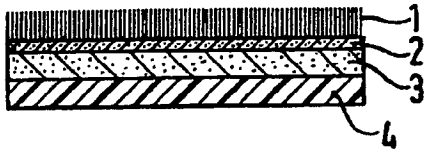

Fig. 1

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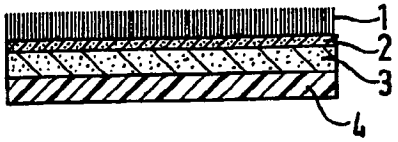

Fig. 1

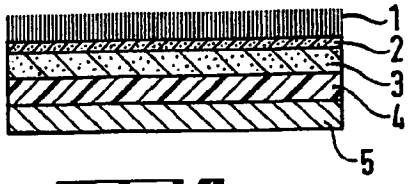

Fig. 2

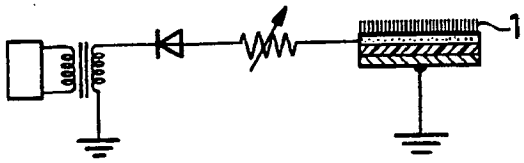

Fig. 3

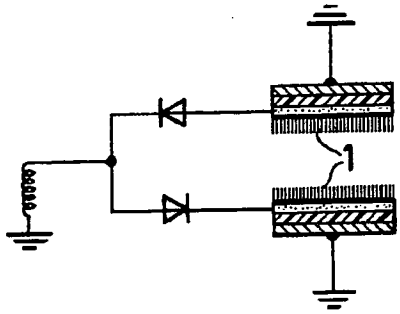

Fig. 4

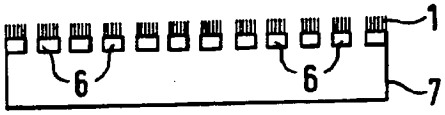

Fig. 5

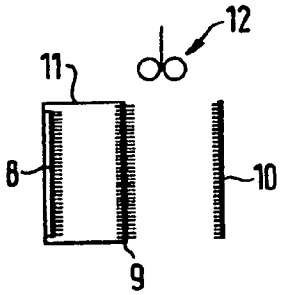

Fig. 6

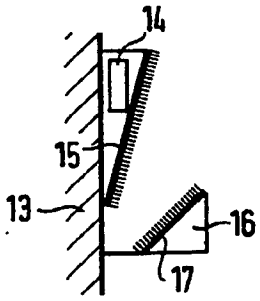

Fig. 7

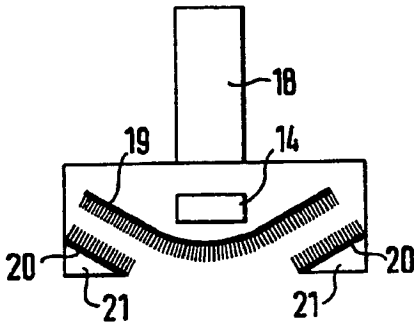

Fig. 8

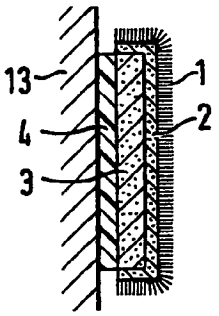

Fig. 9

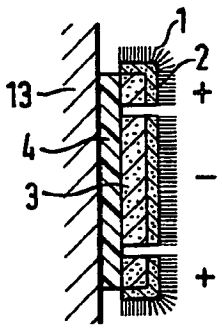

Fig. 10

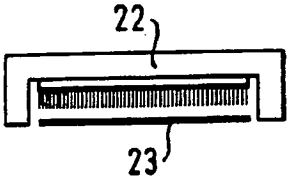

Fig. 11

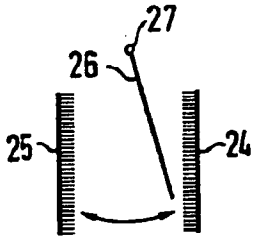

Fig. 12

SPECIFICATION

Electrodes for electrostatic purposes

The present invention relates to electrodes particularly for use in electrostatic applications e.g. such as gas purification plants, air filters, bio-electronics, electric air conditioning, appliances for discharging electrostatically charged materials and the like.

The invention relates more particularly to the production and application of electrodes for discharge or reception of electrical charges, as applied for example in gas purification plants, as well as in the spheres of bio-electronics and air conditioning. The electrodes may also be applied in other preponderantly electrostatically oriented ranges of problems, e.g. such as in the case of reduction of electrostatic charges on plastics materials surfaces or for a variety of cleaning purposes.

Electrostatic filters are applied in increasing degree in gas and air purification. Electric filters offer some advantages as compared to mechanical filters. For example, they prevent degradation of the filter elements and the replacement of the latter enforced thereby. Above all however, it is also possible to separate particles of a grain size of less than one micrometre by means of electrostatic filters. Particles of this nature would pass through the conventional mechanical filters without impediment. This applies not only to dust particles of the smallest size, to vapours and odour particles, but also to micro-organisms.

Electric gas purification devices commonly incorporate two stages. The impurities which are to be separated (soot, dust particles, gases, vapours, a.s.o.) are ionised, i.e. charged electrically, during the first stage. The charged particles are then precipitated by electrostatic forces on appropriately polarised separator electrodes and may be removed by different methods such as knocking off or washing off.

The ionisation is commonly performed by means of many different kinds of discharge electrodes. In doing so, the electrostatic needle effect or corona discharge is exploited, which apart from an adequately high voltage merely requires a minimum radius of curvature of the electrode or of components thereof. Accordingly, metal tips, edges and corners or thin-gauge wires are utilised in a variety of arrangements. The charges given off by the tips and the ions formed by impingement actions attach themselves to the soiling particles. The charged particles are then separated at the counter-electrode. Since the fields generated by such electrodes are highly inhomogenous, electrically neutral particles may also be affected by means of the polarising action (dipole formation and electrostatic forces on the dipole). Additional particles are charged by direct contact with the electrode.

The high speed of the electrodes and ions in the vicinity of the said tips renders the generation of ozone by impingement actions unavoidable moreover in this kind of ionisation. This secondary effect is undesirable and disadvantageous in living and working spaces in particular, due to the toxicity of ozone. Since, moreover the most advantageous operating voltage in the case of such devices lies barely below the flashover voltage, complex stabilising circuits are required for the electrode voltage, for optimum application. The substantial electrostatic forces between the separate electrode components moreover require comparatively complex fastening and suspension systems, since altered gaps would increasingly result in flashover. At the high voltages applied, it is evidently also necessary to make provision for adequate contact protection by means of current limiter circuits or protected installation. On the whole, this leads to rather complex design of these systems. The task is eased in purifying the internal atmosphere in human living and working spaces inasmuch as the aerosols which are to be eliminated are, to a large extent, already charged. Light ions and electrons which are formed by ionising actions of the radioactive earth radiation, cosmic radiation and the like, are attached very rapidly to larger nucleii, dust and odour particles.

Electrodes of the nature of the discharge and needle electrodes hereinabove described have recently also been utilised for electric air conditioning. It proved possible as a matter of fact to demonstrate that the atmospheric electricity, namely the number of ions within the air and the field generated by these and in this connection, especially the ratio between the number of positive ions and the number of negative ions, has an effect on fitness and health. A preponderance of negative ions and an electrical field with the positive pole in the ionosphere, and having a field strength of approximately 130 V/m close to the ground, prevail in the natural atmosphere under normal conditions. Deviations from this ratio were discovered to be harmful and have an action tending towards weakened concentration, accelerated fatigue, increased risk of infection and the like. Thus the known ills caused by warm humid winds such as the Swiss Föhn wind, are thus at least partially ascribed to the action of atmospheric electricity. The electrical conditions are always disturbed in greater or lesser degree in enclosed spaces and vehicles. A preponderance of positive ions prevails as a rule; the electric field is screened off by Faraday cages (e.g. concrete-steel buildings). Bio-conditioning systems and ionisers consequently have the task of re-establishing natural electrical conditions. The great disadvantage of the devices which are already known again primarily consists in generation of ozone

in particular, especially in the case of needle-like electrodes, but also at the edges of areal electrodes.

It is an object of the invention to provide an electrode with which an electrical field of optimum uniformity may be generated even over a larger surface area, as a result of which a uniform ionisation may be secured. It is also the object to reduce the cost of production and safety measures by virtue of lesser complication, as well as to assure an universal application of the electrode.

The invention consists in an electrode, particularly for electrostatic applications wherein a polymeric or textile nap or web having low fibre conduction values at the connection side is connected to the current supply or return side via a high-ohmic composite lamellar resistor which may also act as an adhesive, and this composite lamellar resistor may if appropriate be applied on an appropriately shaped rigid or flexible insulator depending on the application of the electrode.

The unexpected advantage of such an electrode consists in that although each individual fibre has a very high resistance with respect to the electrode element carrying current, the total conductivity value of the large-area electrode is retained by virtue of the summation of the numerous individual conduction values. Whereas conventional electrodes substantially give off charges in marginal areas only (needle effect), charges are given off uniformly by the area as a whole in the case of an electrode according to the invention, by virtue of the surface structure of the said nap. Moreover, no, or substantially no, corona discharges occur at the fibre extremities, in view of the resistance values of the fibres. The forming of ozone is thereby prevented or minimised. The occurrence of unacceptable contact current intensities is also prevented or minimised by the high internal resistance, even at very high operating voltages. A high resistance of the adhesive or of the composite lamellar resistor, provides complementary safety. Other safety measures are therefore unnecessary. Moreover there is no or any little risk of flashover, for the same reasons. Stabiliser circuits, as otherwise customary in the case of electric filters for example, are substantially eliminated.

According to a preferred embodiment of the invention, it is proposed that the nap or pile utilised should consist of natural materials having appropriate electrical properties e.g. such as natural pelts or skins, since these are inherently endowed with appropriate electrical properties and equally have a multiplicity of fibres through which the charges may be given off in accordance with the invention.

According to another embodiment of the invention, polymeric fibres and in particular such as are appropriate for electrostatic precipitation coating, or fabrics formed from these fibres, are utilised as the said nap or pile. In the case of application of polymeric fibres, it is advantageous that these may be set at a desirable fibre conduction value by an initial chemical treatment and that the electrode discharge quantity dissipated may thereby be established.

If desired, the nap or pile utilised may consist of highly polymeric fibres, in particular such as are appropriate for coating by electrostatic precipitation, or of fabrics produced from these fibres, which are primarily characterised by their polarisation reversal property, whereby it is possible to obtain a charge multiplication in the case of an air flow sweeping thereover, and thus an increase by a multiple factor of the action of the electrode.

Advantageously the nap or pile utilised may consist of composite materials or composite fabrics, or those in which the electrical conductivity value of the nap or of the nap fibres is adjusted to particular values, preferably by chemical processing. In this way, the charge dissipation of the electrode may be varied in simple manner within very wide limits.

It is also possible to apply a further conductive layer on the rear side of the insulator on which the composite lamellar resistor is placed. The electrode may thus be utilised as a capacitor and may simultaneously be utilised for smoothing superimposed pulses. The effect of two electrodes according to the invention may be doubled by operating them in phase opposition.

In another embodiment of the invention, provision is made for applying the composite lamellar resistor in the form of a conductive lacquer on the nap, preferably on a textile fabric or pile fabric. This enables already available textile coverings such as carpets or the like to be used to build up the electrical field or to dissipate the charge, in particular in the case of devices for indoor spaces.

In yet another embodiment, it is possible for the connection of the nap, preferably of a firm synthetic fibre fabric, to be established by means of a second lattice-like, reticular or laminar material treated with a conductive lacquer, with which the nap is placed in contact. This embodiment is characterised in that in the case of electrostatic filters or conditioning plants for an indoor atmosphere, the electrical field may rapidly be adapted to different conditions merely by replacement of the nap or rather synthetic fibre fabric.

An embodiment in which the nap is situated on grids and webs and the container situated behind the same and for example having the same polarity serves the purpose of receiving the electrostatic precipitations, is of special advantage. The deleterious substances which are to be removed may thereby be separated in uncomplicated manner, since the particles can no longer emerge from the container in view of the repolarising actions causing them to acquire a charge of the same sign as the

electrode upon passing over coated webs. They are actually repelled by the surfaces of the container which all have the same potential as the particles of deleterious substance.

Another advantageous embodiment includes two electrodes of which at least one comprises a nap situated on a grid or webs co-ordinated for example with an equipolar container for reception of the electrostatic precipitation, said electrodes being combined into an electrostatic filter, since the effectiveness of electrostatic filters may thereby be increased substantially. One electrode may also be appreciably smaller than the other or may be constructed with narrow widely spaced webs to generate fields of maximum inhomogeneity. The advantages of the electrode may thereby also be fully exploited in special cases of application requiring inhomogenous fields on technical grounds.

The electrode may be used to act as a separator electrode within an electrostatic filter, in which the ionisation is performed by known methods, e.g. by discharge actions. Existing electrostatic filter plants may thus be re-structured utilising the advantages of the instructions according to the invention, without great expense.

In another advantageous emobidment, two or more electrodes are incorporated in a mobile appliance in such manner that the appliance may receive dust and other small particles in similar manner to that of a vacuum cleaner. The effect of the electrical field may thereby also be utilised for conveying particles, and complex and troublesome blowers and the like may be omitted. In this connection, it is advantageous for at least one electrode to be constructed as a rotatable roller.

Furthermore the electrodes may be utilised for electrical air conditioning by generation of an electrostatic field and for ionisation of the air, or in which the electrodes are constructed as wall-mounted, ceiling-mounted or desk top appliances. The multiplicity of advantageous cases of application of the invention derives from this circumstance.

In another embodiment, provision is made for the electrodes which may for example be of areal form, to be of opposed polarity in the marginal areas, the central portion of the electrodes and the marginal portion being electrically separated. This prevents settling of ionised particles around the electrode, since these are repelled by the oppositely polarised portion.

Moreover the electrodes may be utilised to reduce the number of harmful micro-organisms in an indoor atmosphere and on the surface of objects or to promote plant growth and, preferably by means of positively polarised electrodes below the roof of conservatories or by means of the geometrical shape of the electrodes to generate a highly inhomogenous field in which insects may be killed.

It is also possible to draw off electrostatic charges, e.g. produced by frictional electricity, via the supply lead to the electrode, that is to say from the actual material of the electrode itself, as well as from such materials as are placed in contact with the electrode or brought close thereto for this purpose. The electrodes may thereby simultaneously be co-opted to prevent build-up of static charges. This proved to be satisfactory in particular in rooms containing electronic appliances, such as in living rooms.

An electrostatic ventilator may be operated by means of two electrodes in such manner that a chargeable sheet performs a charge transfer between the electrodes, since an air circulation may thereby be obtained without rotary elements and without a mechanical drive.

In another application, the electrode may be installed on the underside of the tone arm in the case of record players to dedust and discharge the record.

It is also possible for the direct voltage applied to the electrode to be modulated for bio-electronic purposes, that is to say preferably at low frequencies within the 5 to 10 Hertz range.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show some embodiments thereof by way of example and in which:–

Figure 1 shows a cross-section through an electrode in accordance with the invention,

Figure 2 shows a modified embodiment of electrode,

Figure 3 shows a fundamental wiring diagram for operation of an electrode according to Fig. 2,

Figure 4 shows a modified embodiment of a fundamental wiring diagram for application of two electrodes according to Fig. 2,

Figure 5 shows a side view of an electrode together with a housing co-ordinated therewith in cross-section,

Figure 6 shows a diagrammatical illustration of an electrostatic filter using two electrodes according to the invention,

Figure 7 shows an arrangement of electrodes for an air purifier in a greatly simpified embodiment,

Figure 8 diagrammatically shows an arrangement of electrodes for reception of particles which are to be separated, within a mobile appliance,

Figure 9 shows an electrode in an arrangement for an air purification appliance,

Figure 10 shows a modified embodiment of an air purification appliance,

Figure 11 shows a diagrammatic arrangement of electrodes for electrostatic discharge during the production of webs of plastics material, and

Figure 12 shows a diagrammatic arrange-

ment of electrodes for separation of dirt particles and for simultaneous generation of an air flow.

Referring now to the drawings, in Fig. 1, the part of the electrode dissipating a charge or acquiring the same consists of a polymeric or textile nap 1. At the adhesion side, this nap is supplied via a high-ohmic composite lamellar resistor 2 and a conductive current supply lead-in of metal or composite lamellar resistor 3. Insulating material 4 which may be rigid or pliable depending on the purpose of its application acts as a base and as a mechanical support. In the case of an appropriate insulating base on which the electrode is to be installed, or in case of appropriate suspension and adequate strength of the—for example textile—fabric, it is also possible to omit this layer. Any desired shape is obviously possible instead of the plate form of Fig. 1.

The nap 1 of said layer may comprise semiconductive polymeric fibres, or alternatively natural materials, provided that these have the appropriate electrical properties, e.g. such as natural pelts or skins. Composite materials may also be envisaged. An electrode coated electrostatically with floccular material, in which an appropriately conductive adhesive which may for example be based on a plastics material already disclosed is referred to as a preferred embodiment, and is utilised for supplying current. For optimum exploitation of the voltage applied, the fibre conduction value of the nap 1 may be adjusted to the desirable value by appropriate and preferably chemical pre-processing, and the quantity of charge dissipated by the electrode may be controlled in this manner. In view of their polarisation reversal property, highly polymeric substances offer another advantage. In view of the air flow sweeping over the same, e.g. impelled by a blower, the result is a multiplication of the charge and an increase by a multiple factor of the electrode action.

In electrodes made according to the invention, each individual fibre may have a very high internal resistance with respect to the electrode section carrying current, but the overall conductivity value of the large-area electrode is retained by summation of the numerous individual conductivity values. Whereas conventional electrodes in essence dissipate charges only in the marginal areas, (needle effect), charges are dissipated uniformly throughout the surface in the case of electrodes according to the invention, in view of the surface structure of the nap 1. The resistance values of the fibres moreover prevent the occurrence of corona discharges at the ends of the fibres. The generation of ozone is thereby prevented or minimised. The high internal resistance moreover prevents the occurrence of unacceptable contact current intensities, even at very high operating voltages. A high resistance of the adhesive or of the composite lamellar resistor 2 provides additional safety. Other safety measures are therefore unnecessary. For the same reason, there is little if any risk of flash-over. Stabilising circuits such as otherwise customary in electrostatic filters for example, are omitted.

In Fig. 2, another conductive layer 5 is applied on the rear side of the insulating material 4. The composite lamellar resistor 3, the insulating material 4 and the layer 5 thus form a capacitor.

The basic circuit in Fig. 3 demonstrates that the electrode may have its capacitive action applied at the same time, e.g. for smoothing superimposed pulses.

Fig. 4 shows how two electrodes connected in appropriate manner may be operated in phase opposition to double their effect.

Air and gas purification plants represent a principal sphere of application of the electrodes. Approximately the following arrangement proved to be satisfactory as an air filter. An electrode according to the invention has a high negative voltage applied to it. A water container which is earthed and is thus electrically positive with respect to the first electrode, acts as a counter-electrode and at the same time as a separator bowl. A fan blows the air which is to be purified between the electrodes. In view of the field between the two electrodes and by recharging actions at the negative electrode, the aerosols are precipitated into the water bath. The addition of paraffin oil or of organic oils, e.g. ordinary edible oil, to the water to prevent evaporation and reduce water surface tension, proved to be necessary since a fraction only of the particles would otherwise, be received by the water and the greater proportion would be reflected. Instead of the water bowl used as a second electrode, it is also possible for a perforated electrode situated right above the water surface to be utilised as a counter-electrode. The water may be, but does not have to be, at the same potential as the electrode. Even the most minute dust particles, odour particles, tobacco smoke, in short all aerosols and micro-organisms, are permanently removed from the air by means of the arrangement described. By appropriate geometrical arrangement of the electrodes, e.g. negative electrodes at the outlet aperture longer than the water bowl, it may be accomplished that the purified air flow is enriched with negative ions to improve the electrical climate within the room in this manner.

Fig. 5 illustrates the manner in which filters of even lower complexity may be constructed. The nap 1 is is applied on grids 6, webs or the like, which are either intrinsically conductive or are provided with a high-ohmic composite lamellar resistor, in several layers of different conductivity, if appropriate. The space situated behind the same, which is enclosed in box-like manner by a housing 7,

serves the purpose of receiving aerosols enclosed. The following method is applied to keep these within the separator space. The housing is placed at the same potential as the electrode. Upon moving past the coated webs or grids 6, the aerosols receive a charge of the same sign as the electrode by virtue of recharging actions. This means that the particles within the separator space are repelled by all the surfaces which all have the same potential. The particles are trapped in the box. To this end, the housing 7 may itself be conductive or may be coated with a composite lamellar resistor alone or with a composite lamellar resistor and polymeric or textile fibres.

Fig. 6 shows an embodiment with which it is possible to increase the effectiveness of a filter of this nature. In this diagram, the filter comprises three electrodes 8,9,10, the housing 11 and the ventilator 12. The electrodes 8 and 9 are positively polarised and the electrode 10 negatively. Electrodes 8 and 9 may also be connected in electrically conductive manner. The ventilator 12 blows the air flow between the electrodes 9 and 10. The aerosols are conveyed by the electrical field through the perforated electrode 9 into the separator space between 8 and 9 and are trapped in accordance with the same principle as specified above. The electrodes within the housing 11 need not necessarily be coated with conductive nap for this purpose. In an extended embodiment, the electrode 10 may also be provided with a separator box, in symmetrical manner.

In rooms containing air having a low degree of contamination only, the operation of an appliance without a ventilator or blower is adequate to remove dust, tobacco smoke and micro particles.

Fig. 7 shows a suitable construction. The appliance is advantageously installed on a wall 13 at median height. A high-tension part 14 is situated behind a slightly sloping negative electrode 15. The recharged aerosols are deposited in a space 16 behind a permeable positive or earthed electrode 17. The larger negative electrode complementarily dissipates negative ions into the room and thereby improves the electrical climate within the room.

If the gas which is to be purified were to contain a high proportion of electrically neutral particles, which does not commonly arise in normal living and working spaces, it is possible to proceed according to the following methods. The gas flow may be directed, e.g. by the blower and ducting systems, in such manner that each particle strikes the electrode at least once and is charged whilst doing so. Another method consists in that the electrical field between the electrodes is arranged to be highly inhomogenous and that the particles are filtered out by polarisation effect. In another stage, say in industrial gas purification plants, it is possible to utilise the known needle-type electrodes or alternatively liquid atomisers—Lenard effect—for ionisation. The electrode according to the invention is then utilised as a separator electrode, e.g. in the embodiment according to Fig. 5.

Mobile appliances may also be constructed in accordance with the principle hereinabove described, to the effect that the particles separated are retained between identically polarised electrodes, which perform the function of a vacuum cleaner.

Fig. 8 illustrates a layout for an appliance of this nature. The H.T. component 14 may optionally be supplied from the mains or by batteries or accumulators stored in a handle 18. An electrode 19 having a construction according to the invention is negatively polarised and exerts a "suction" effect on dirt particles, paper cuttings, dust, microbes, etc. These are recharged at the electrode 19, attracted by one of oppositely polarised perforated electrodes 20 and retained in a separator space 21 all the surfaces of which again carry the same potential.

A vacuum cleaner of this kind operates in wholly noiseless manner, without wearing parts and above all removes even the most minute particles which are blown back into the room through the dust bag by conventional vacuum cleaners. It may be utilised independently of the supply mains, and may also be applied in places in which it is impossible to operate with conventional vacuum cleaners, for example for dusting indoor plants or removing dust at working stations littered with sheets of paper or small-size components because only very small and lightweight particles are removed, but thoroughly so in exchange. The removal of dust from books, records, tumblers and analogous affected materials also forms part of the potential range of operation. Clothes "brushes" for example, may also be constructed in accordance with the same principle. The electrode 19 may be constructed in the form of a rotatable roller-shaped brush for this purpose, which projects a little beyond the rim of the housing. Apart from the filtering action as already stated, the electrodes may also be applied advantageously for electrical conditioning of an indoor atmosphere, that is to say to generate the right electrostatic field and the surplus of negative air ions. Simple appliances intended for this purpose resemble the filter in Fig. 7, which is actually a combined filter and ioniser combination applicance. The separator space 16 and the electrode 17 are omitted in climatising appliances as such.

Figs. 9 and 10 show the simplest embodiments. The electrode in Fig. 10 is negatively charged in its middle portion only, but is positively charged at the edges. This prevents possible residual marginal effects and more extensive soiling of the marginal areas and of

the surrounding surface. If use is made of electrodes according to Figs. 9 and 10 as ceiling electrodes in order to simulate natural field conditions within the room, they will obviously have to be polarised positively. Simple electrodes of this kind also act partially as air filters because the ionised aerosols are deposited either on the electrode itself by the electrostatic field generated by the electrode, or on the surfaces of the walls and items of furniture.

It has been determined experimentally that the number of noxious germs in rooms containing a correctly polarised field and a surplus of negative ions is substantially lower than the number of germs in untreated rooms. Appliances causing ionisation and generating fields are consequently advisable for hospitals, for example. In the latter, they may also replace other appliances usually used at this time, which commonly have harmful side effects, say like UV radiators or ozonifying appliances. The keeping period of foodstuffs in storage may be extended in storage sheds, in this manner.

An electrode, for example constructed in tubular form, which is installed under the roof and positively polarised, proved to be satisfactory in glass houses. The metal frame of the glass house acts as the counter-electrode. The Faraday cage effect of the glass house is balanced and similar field conditions to those as prevail in the open air are established within the glass house. The growth of the plants is thereby stimulated, and numerous diseases are prevented, such as fungal plant attack and the like.

The greatest field gradient evidently occurs between the electrode and the roof, in view of the small distance. The field gradient reaches such magnitude at this point that small insects are attracted and killed. It also proved to be possible to operate effective gnat or midge traps successfully in indoor spaces as well as on camp sites in accordance with this principle, even in territories greatly infested with midges or gnats.

The fact that the correct ionisation conditions not only contribute in preventing disease, but also co-operate in combating fatigue and loss of concentration, proved to be demonstrable in large working spaces and for example even in public transport vehicles. Appliances of this nature may be produced more easily and cheaply than those currently available, with an electrode according to the invention, apart from eliminating the troublesome by-product ozone. It is now also possible to produce small and very uncomplicated ionising appliances which may be set up on writing desks and bedside tables. The simplest procedure is to paint plastics material housings of any desired shape with a conductive adhesive and to coat the same electrostatically with a floccular material. The electronic component for the high negative potential is stowed within the housing.

A complementary improvement of the electrical indoor climate is obtained by imposing a low-frequency modulation on the high static potential. In particular, the modulation at 10 Hertz known from the natural atmosphere, secures the best results, be it for increased capacity of concentration, improved wellbeing or else for accelerated plant growth. Depending on the structure of the electronic pulse transmitter, the construction of the electrode as a capacitor according to Fig. 2 may be particularly useful in this case.

Apart from the repeatedly referred to embodiment of the electrode comprising a coating of electrostatically precipitated floccular material, textile fibres and fabrics consisting preponderantly of plastics material are also appropriate as the said nap. The woven textile material, e.g. a piece of plastics material carpet, need merely be coated on the rear side with an electrically conductive lacquer for this purpose, and this lacquer need merely be electrically connected. It is also adequate however to establish an intimate contact between the textile element and a grid-like or reticular material for example or a sheet, which had been treated with the said lacquer. It is already sufficient in many cases to lay the two parts one on the other.

Apart from application as electrostatic filters and ionising appliances in the manner hereinbefore described, this particular embodiment of the electrode broaches another important sphere of application of the method: it is a known phenomenon that most plastics material are charged electrostatically by friction (e.g. by walking with synthetic soles on plastics material flooring, or sitting on seats having plastics material covers, e.g. as in motor cars and so on). Discharges involving unpleasant sparking occur upon touching metal elements such as door handles, steel railings and so on. If such materials are coated on the underside in the manner referred to above with an electrically conductive plastics material layer or painted with conductive lacquer, and this layer is then connected up and earthed or placed at an appropriate potential, the electrostatic charge is immediately drawn off or balanced.

The electrode produced in this manner may also be utilised for electrical indoor climatisation at the same time. An improvement already occurs merely because of the disappearance of the interference fields generated by statically charged plastics materials. A plastics material carpet treated in the manner described thus performs several tasks in an ideal combination: electrostatic charging of the material by frictional electricity is prevented; the negatively polarised carpet establishes field conditions within the room which are analogous to those prevailing outdoors (130 V/m

from top to bottom); the electrode operates as an ionising appliance and generates the desirable ratio between the numbers of ions, namely a surplus of negative ions. Finally, the carpet acting as an electrode of an air filter reduces the quantity of ionised aerosols in the air, in the manner described. In view of the low conduction values, there is no risk as regards safety, nor is any ozone generated. A low-frequency modulation (e.h. 10 Hertz) may also be superimposed in this case, as will be apparent.

Apart from the purpose specified, an electrode according to the invention may also be applied for numerous other special tasks, of which a few are pointed out hereunder as being representative: If the electrode is installed on the underside of the tone arm of a record player, the record revolving below the same is dedusted and discharged thereby.

Fig. 11 shows a diagrammatic cross-section of an electrode 22 utilised in the production of plastics material webs, in which the powerful electrostatic charge makes itself felt in troublesome manner. The electrode 22 may equally be applied advantageously in its case. The web 23 which is to be produced is passed through under an electrode 22 according to the invention to discharge said web.

An electrostatic ventilator which may easily be embodied with the electrodes described, is depicted in Fig. 12. Between the two electrodes 24,25 is situated a sheet 26 of a chargeable and for example semi-conductive material, which is movably suspended at one edge 27. The sheet 26 is charged, e.g. by the negative electrode 24, is repelled because of the equipolar charge, and is attracted by the positive electrode 25. A reverse charging action occurs at the latter. The sheet 26 which is then positively charged performs a stroke back to the negative electrode 24, and so on and so forth. This pendular displacement during which charge is evidently conveyed, that is establishing a flow of current, forces air through between the electrodes 24,25 and thus plays a part in convection and ventilation.

CLAIMS

1. An electrode particularly for electrostatic application, wherein a polymeric or textile nap or web having low fibre conduction values is connected to the current supply or return side at the connection side via a high-ohmic composite lamellar resistor which may also act as an adhesive, said resistor being applied on an appropriately formed rigid or pliable insulator depending on the application of the electrode.

2. An electrode as claimed in claim 1, wherein natural materials having appropriate electrical properties, e.g. natural pelts or skins, are utilised as the said nap.

3. An electrode as claimed in claim 1, wherein polymeric fibres and in particular such as are appropriate for electrostatic coating with floccular material, or fabrics of these fibres, are utilised as the said nap.

4. An electrode as claimed in claim 1, wherein highly polymeric fibres and in particular such as are appropriate for electrostatic coating with floccular materials, or fabrics of these fibres, are utilised as the said nap.

5. An electrode as claimed in claim 1, wherein composite fabrics are utilised as the said nap.

6. An electrode as claimed in any of claims 1 to 4, wherein the electrical conductivity value of the nap or of the fibres of the nap is adjusted to particular values by chemical treatment.

7. An electrode as claimed in claim 1, wherein a further conductive layer is applied on the rear side of the insulator on which is situated the composite lamellar resistor.

8. An electrode as claimed in claim 1, wherein the composite lamellar resistor is applied in the form of a conductive lacquer on the nap of a textile fabric or pile fabric.

9. An electrode as claimed in claim 1, wherein the connection of the nap of a firm synthetic fibre fabric is established via a lattice-like, reticular or laminar material treated with conductive lacquer, with which the nap is placed in contact.

10. An electrode as claimed in claim 1, wherein the nap is applied on grids and webs, and a container situated therebehind and which has the same polarity, serves the purpose of receiving the electrostatic precipitations.

11. An electrode as claimed in claims 1 and 10, wherein two electrodes of which at least one has a nap applied on grids or webs and is co-ordinated with an equipolar container for reception of the electrostatic precipitations, are combined into an electrostatic filter.

12. An electrode as claimed in claims 1 and 11, wherein one electrode is appreciably smaller than the other, or is constructed with narrow widely spaced-apart webs, to generate fields of maximum inhomogenity.

13. An electrode as claimed in claim 1 and 10, wherein the electrode acts as a separator electrode in an electrostatic filter, in which the ionisation is performed by known methods.

14. An electrode as claimed in claims 1 and 10, wherin at least two or more electrodes are installed in a mobile appliance, in such manner that the appliance may receive dust and other small particles in similar manner to that of a vacuum cleaner.

15. An electrode as claimed in claims 1, 10 and 14, wherein at least one electrode is constructed as a rotatable roller.

16. An electrode as claimed in claim 1, wherein the electrodes are utilised for electri-

cal indoor climatisation by generating an electrostatic field, and for ionising the air.

17. An electrode as claimed in claim 16, wherein the electrodes are constructed as wall-mounted, ceiling-mounted or desk-mounted appliances.

18. Electrode as claimed in claims 1 and 16, wherein the electrodes, which are constructed in areal form, are oppositely polarised at the marginal portions, the central portion of the electrode and the marginal portion being separated electronically.

19. An electrode as claimed in claims 1 and 16, wherein the electrodes are utilised to reduce the number of harmful micro-organisms in the indoors atmosphere and on the surface of objects.

20. An electrode as claimed in claims 1 and 16, wherein the electrodes are utilised to promote plant growth, preferably by means of positively polarised electrodes under the roof of glass houses.

21. An electrode as claimed in claims 1 and 12, wherein a highly inhomogoneous field is generated by appropriate geometrical shaping of the electrodes, in which field it is possible to kill insects.

22. An electrode as claimed in claims 1,8 and 9, wherein electrostatic charges generated by frictional electricity are drawn off via a supply lead of the electrode, from the electrode material itself, as well as from materials which are placed in contact with the electrode or close thereto.

23. An electrode as claimed in claim 1, wherein an electrostatic ventilator or blower is operated by means of two electrodes by the fact that a chargeable sheet performs a charge conveying action between the electrodes.

24. An electrode as claimed in claim 1, wherein the electrode is installed in the underside of the tone arm in record players to dedust and discharge the record.

25. An electrode as claimed in claim 1, wherein a direct voltage fed to the electrode is modulated for bio-electronic purposes, at lower frequencies within the range 5 to 10 Hertz.

26. Electrodes for electrostatic applications substantially as hereinbefore described with reference to the accompanying drawings.

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